

Emerging Per- and Polyfluoroalkyl Substances (PFAS)

Andrew B. Lindstrom¹, Jason E. Galloway², Mark J. Strynar¹,
Detlef Knappe³, Mei Sun⁴, Seth Newton¹, Linda K. Weavers²

¹U.S. Environmental Protection Agency, ²The Ohio State University,
³North Carolina State University, ⁴University of North Carolina Charlotte



Northeastern University
*Social Science Environmental Health
Research Institute*

Highly Fluorinated Compounds
Social and Scientific Discovery
Northeastern University Social Science
Environmental Health Research Institute
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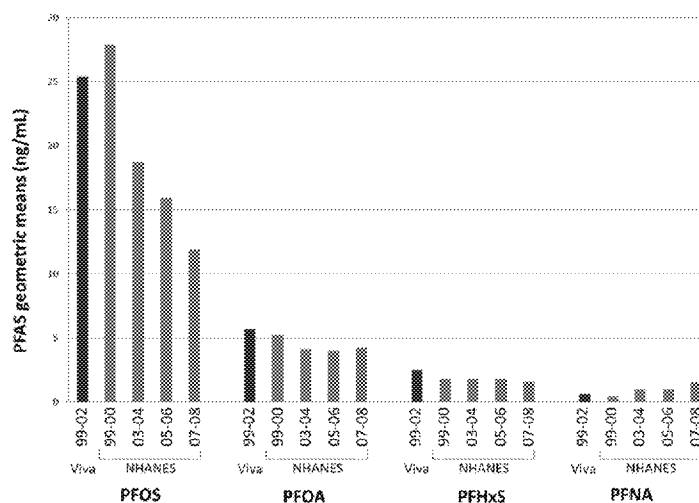
Overview

- Sources and exposure pathways of legacy PFAS (PFOS & PFOA) somewhat known
- USEPA's Stewardship Program has reduced legacy PFAS but has also resulted in the development of many new "emerging" PFAS
- New analytical capabilities (high resolution mass spectrometry) allow detection of many new PFAS
- Emerging PFAS almost completely uncharacterized with regard to sources, environmental fate, human exposure implications
- Discussion of some recent research on sources of emerging PFAS, human exposure pathways, overall implications

US Environmental Protection Agency PFOA Stewardship Program

- In January 2006, USEPA started this program to help minimize impact of PFOA in the environment
 - Eight major international companies have agreed to participate (including 3M, DuPont, Asahi Glass, Daikin)
 - Agreement to voluntarily reduce factory emissions and product content of PFOA and related compounds* on a global basis by 95% no later than 2010
 - Agreement to work toward total elimination of emissions and product content of these compounds by 2015
 - Based on emissions and content determinations made for 2006
- * Includes PFOA, precursor chemicals that can break down to PFOA, higher homologues (C9 and larger)

Trends in PFAS Serum Levels in US



Sagiv et al. *Environmental Science & Technology* 2015, 49, 11849–11858

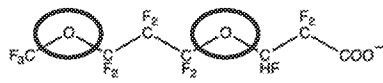
Table 2. Geometric mean and 95% confidence interval and selected percentiles of PFOS, PFOA, PFHxS, and PFNA serum concentrations (ng/mL) for the U.S. population 12 years of age and older: Data from NHANES 2011–2012 ^a

	Geometric Mean (95% Confidence Interval)		Selected Percentiles			
			50 th	75 th	90 th	95 th
PFHxS	1.28	1.15-1.43	1.27	2.26	3.81	5.43
PFOS	6.31	5.83-6.82	6.51	10.48	15.62	21.68
PFOA	2.08	1.95-2.22	2.08	3.02	4.35	5.67
PFNA	0.88	0.80-0.97	0.86	1.30	1.95	2.54

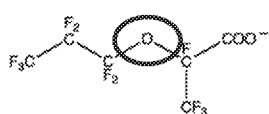
^a CDC (2015)

Fluoropolymer manufacture

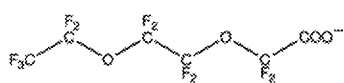
ADONA (CAS No. 958445-44-8)



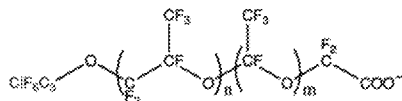
GenX (CAS No. 62037-80-3)



Asahi's product (CAS No. 908020-52-0)

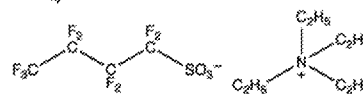


Solvay's product (CAS No. 329238-24-6)

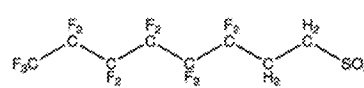


Metal plating

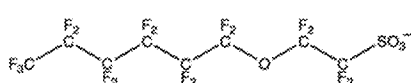
N(Et)₄-PFBS (CAS No. 25626-08-4)



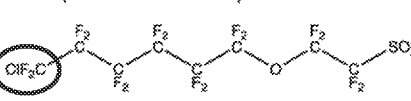
6:2 FTSA (CAS No. 27619-97-2)



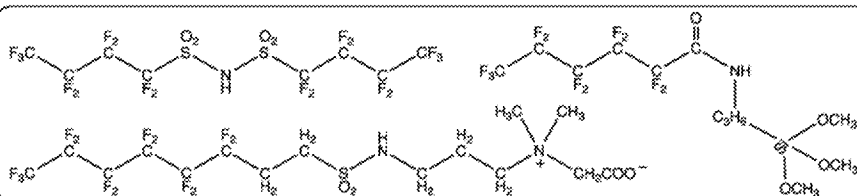
F-53 (CAS No. 754925-54-7)



F-53B (CAS No. 73608-19-6)



Fire fighting foams and miscellaneous

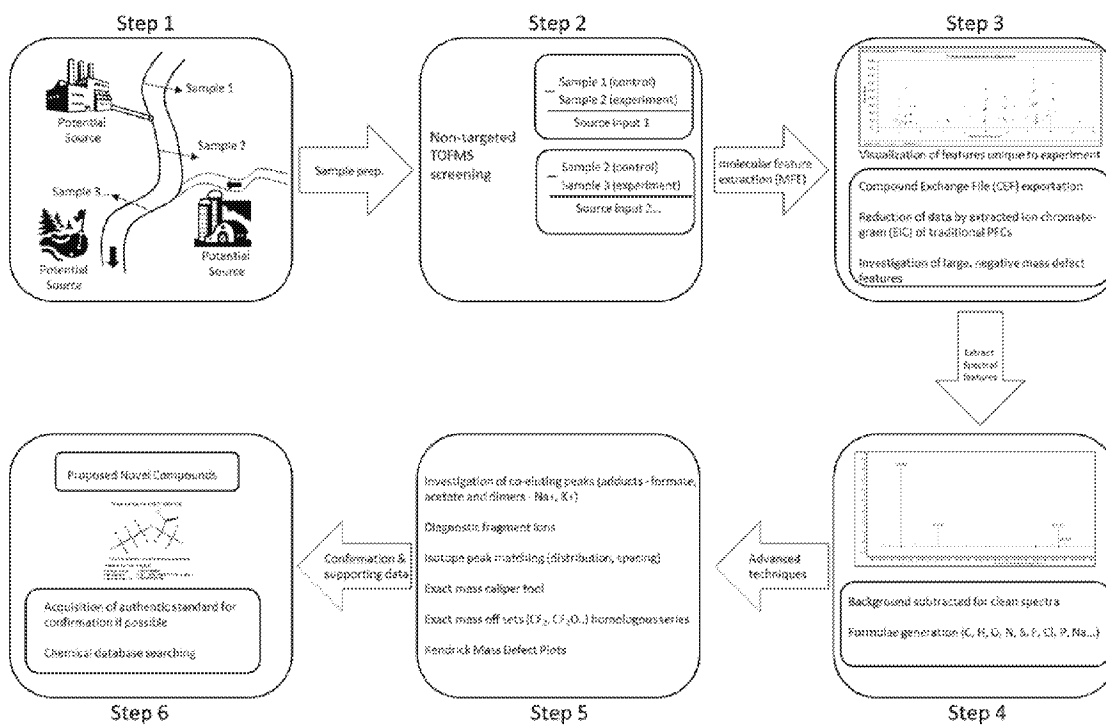


Unknown Characteristics of “Emerging” Fluorinated Compounds

- Actual identities of alternatives unknown in industrial sectors and geographical regions that are not well regulated
- Data on environmental and human health effects are incomplete (at best) and more often nonexistent
- Data on degradability, bioaccumulation, and toxicity (environmental and human) are incomplete (at best) or completely lacking
- Information on production volume and environmental emissions not available

Wang et al. *Environment International* 2013, 60, 242–248

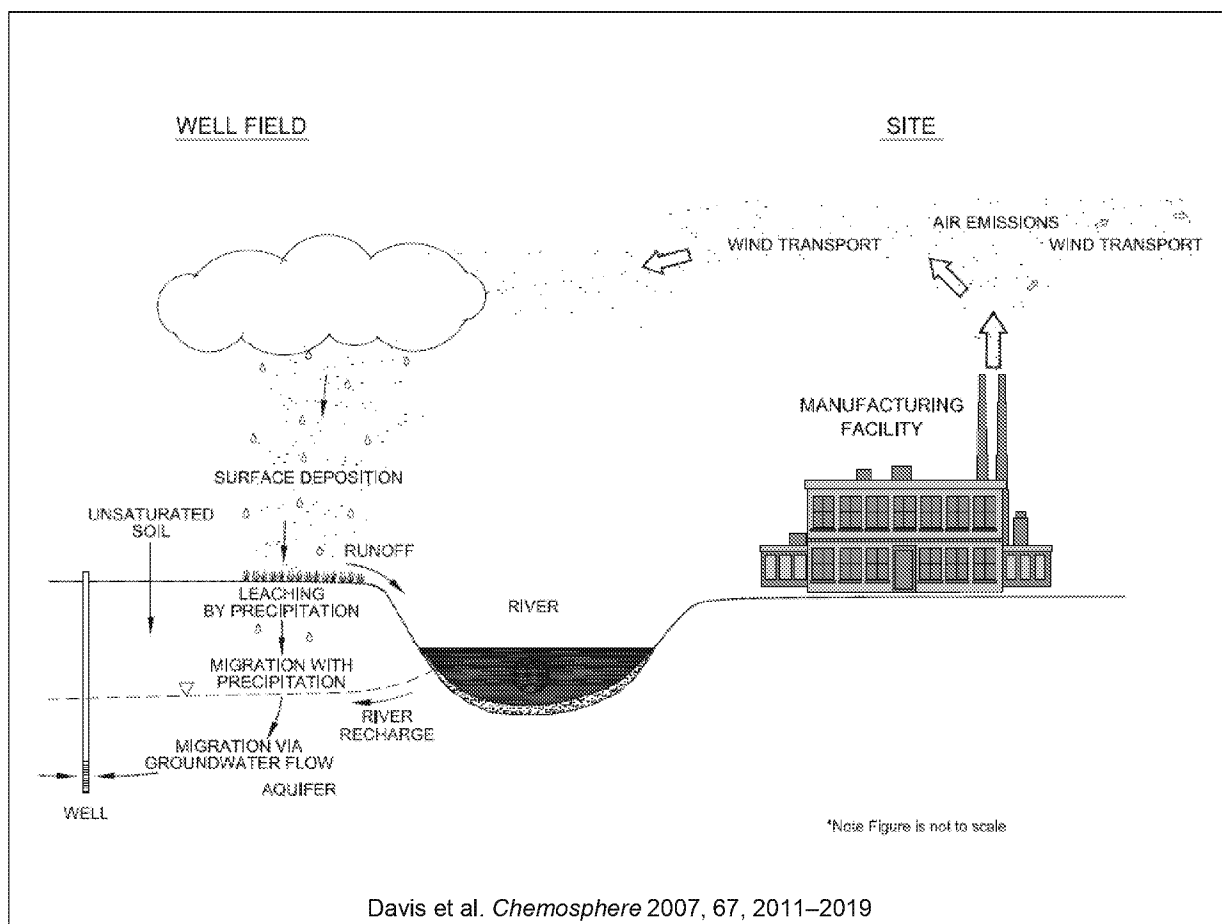
High Resolution Mass Spectrometry to Find “Emerging” PFAS

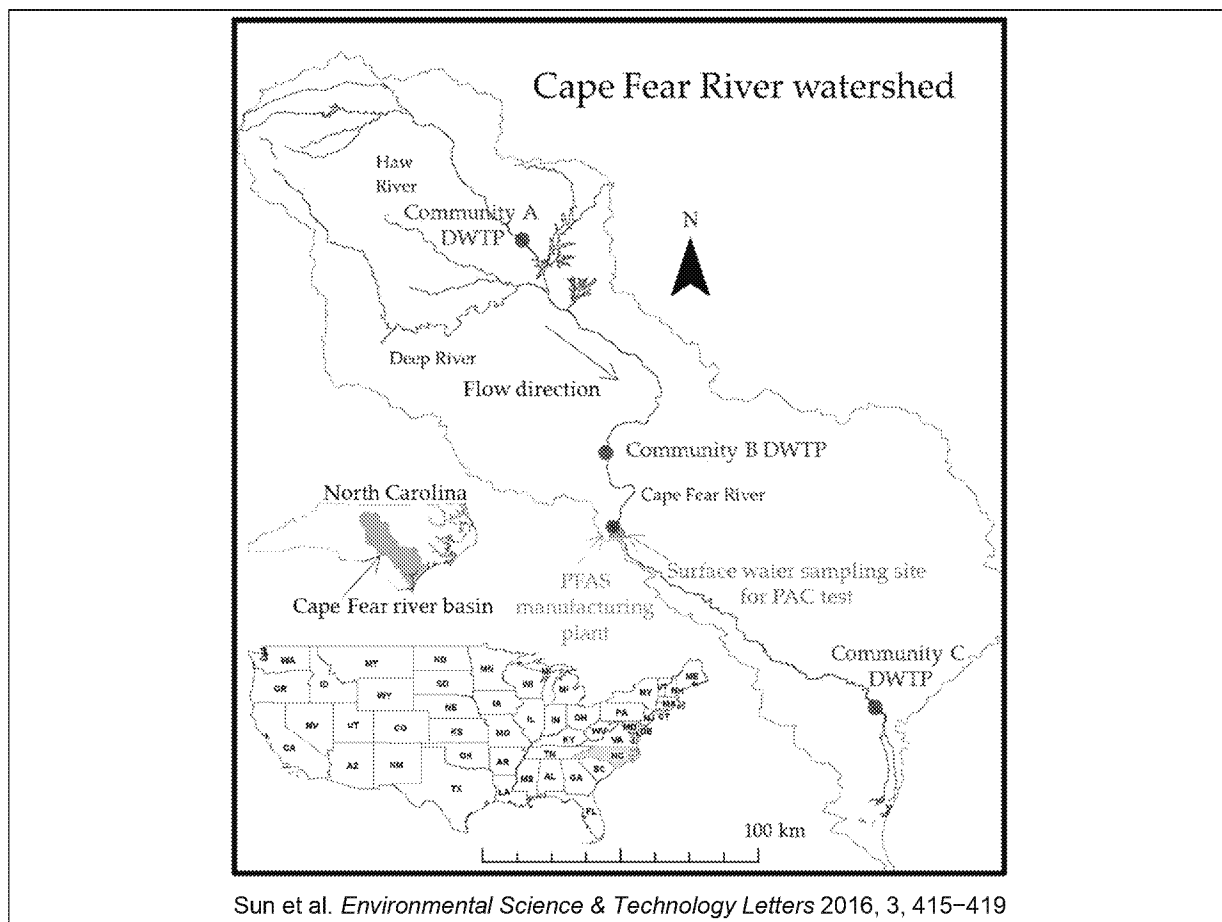


Strynar et al. *Environmental Science & Technology* 2015, 49, 11622–11630

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Work approached for detection not quantification

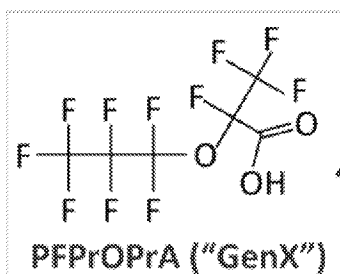
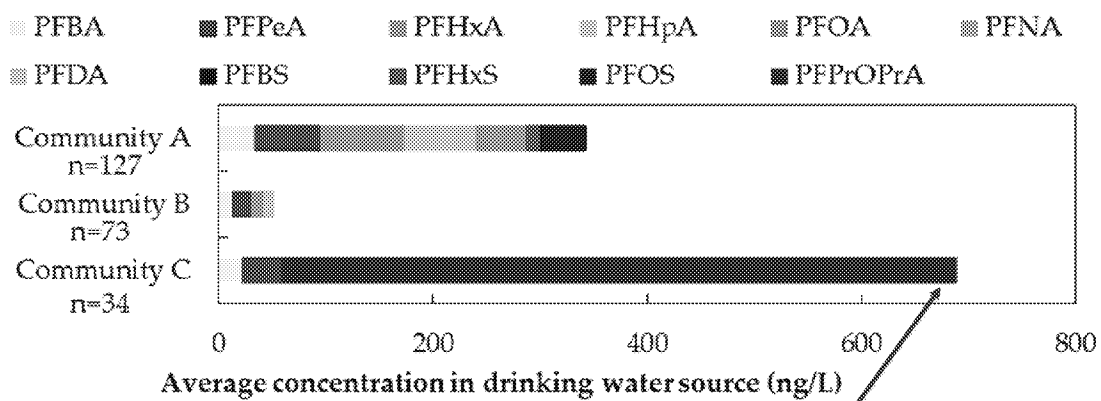




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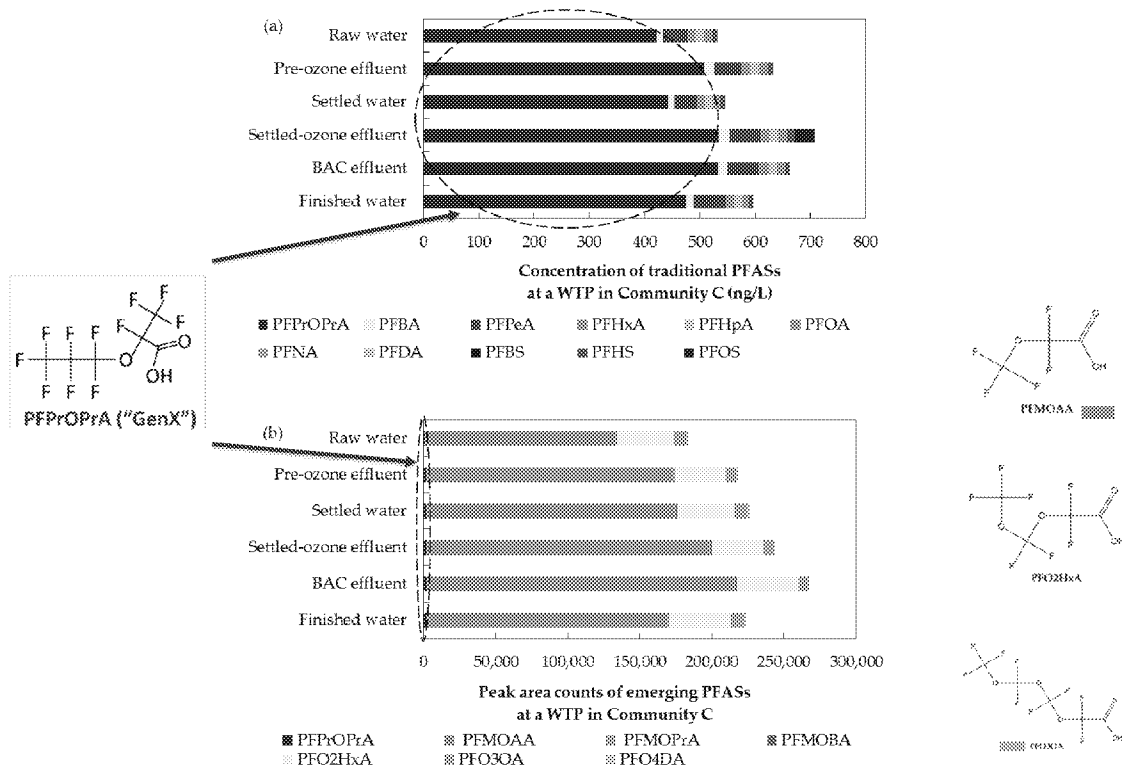
Work approached for detection not quantification

Legacy PFAS with GenX in Cape Fear River Basin

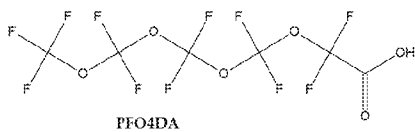
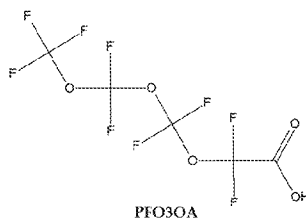
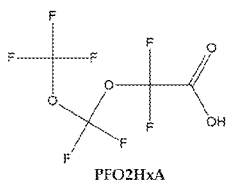
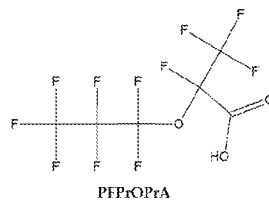
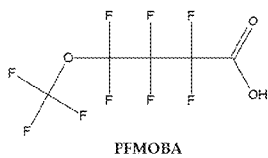
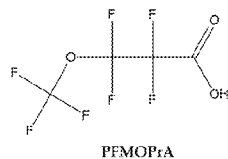
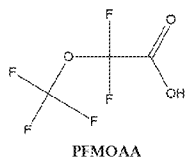


Sun et al. *Environmental Science & Technology Letters* 2016, 3, 415–419

Emerging PFAS in Cape Fear River Basin



Sun et al. *Environmental Science & Technology Letters* 2016, 3, 415–419



Sun et al. *Environmental Science & Technology Letters* 2016, 3, 415–419

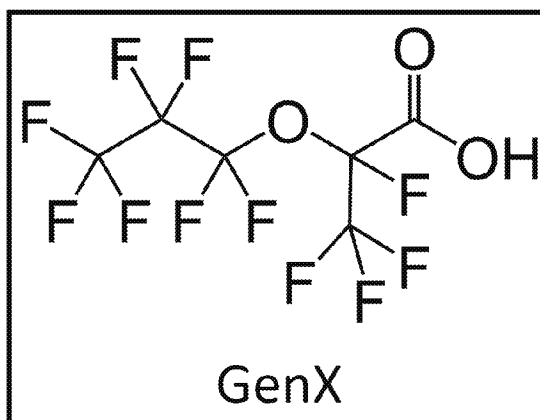
GenX

- Identity originally protected as Confidential Business Information (CBI)

- Still persistent, still toxic, but less bioaccumulative than C8

- DuPont studies found effects on rats similar to C8, including possible endocrine/immune disruption, enlarged livers and kidneys, and cancer

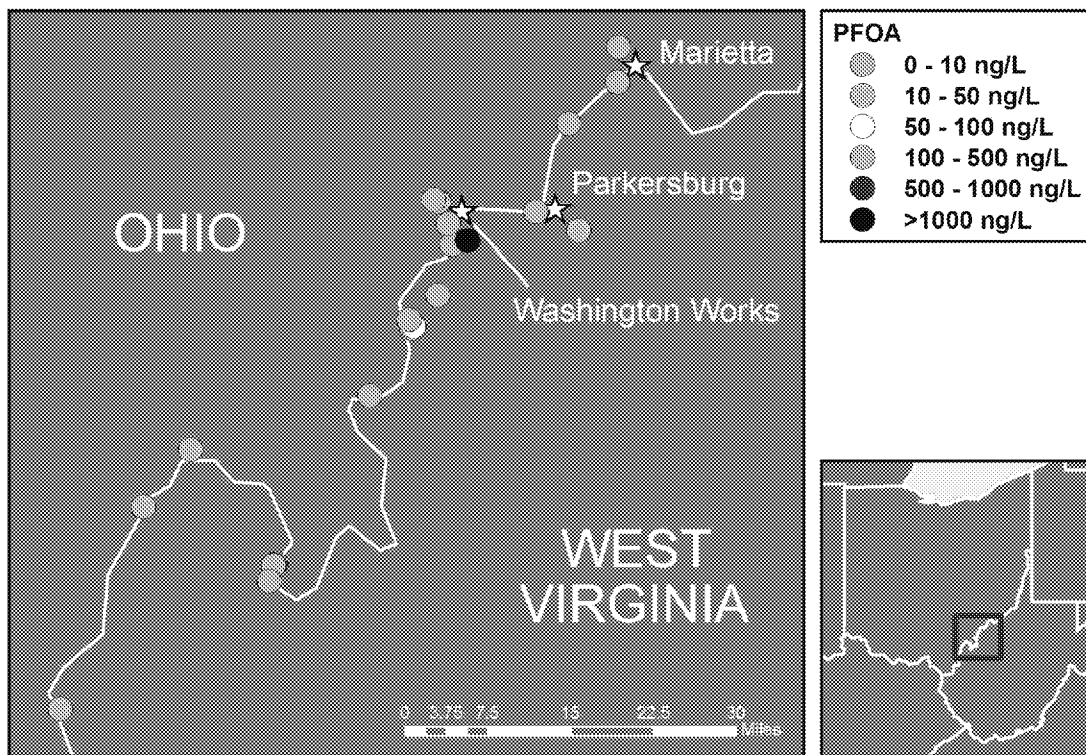
- Approved by the EPA, no further testing required



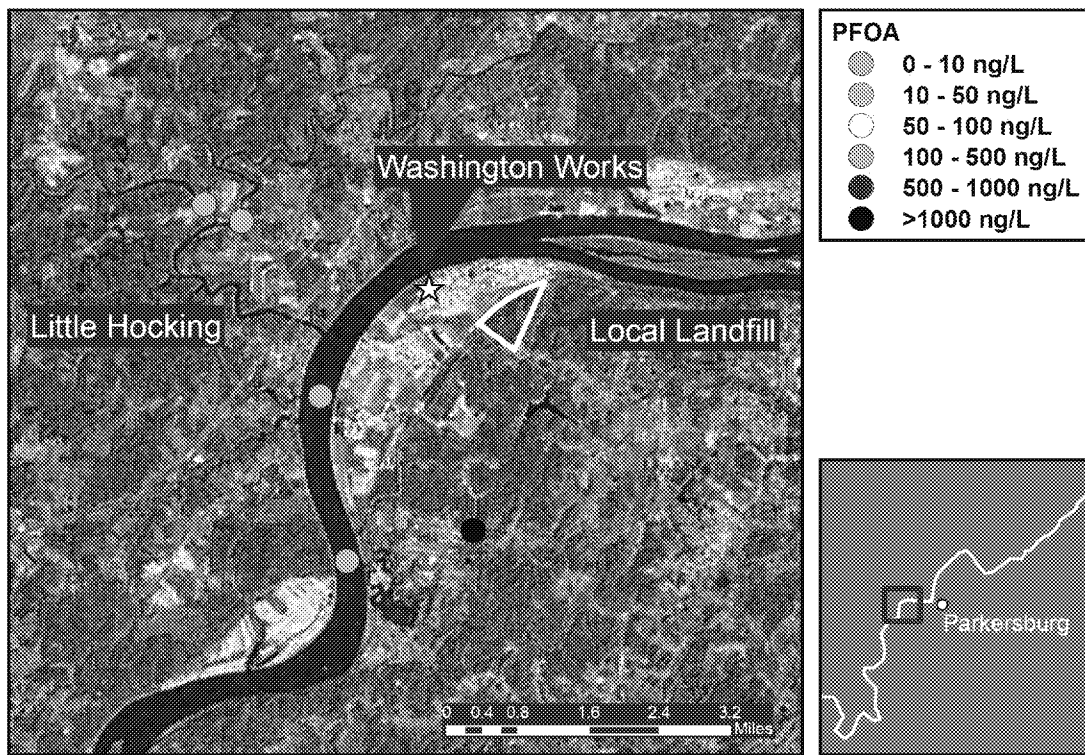
Trip #1 – Ohio River



Ohio River Results

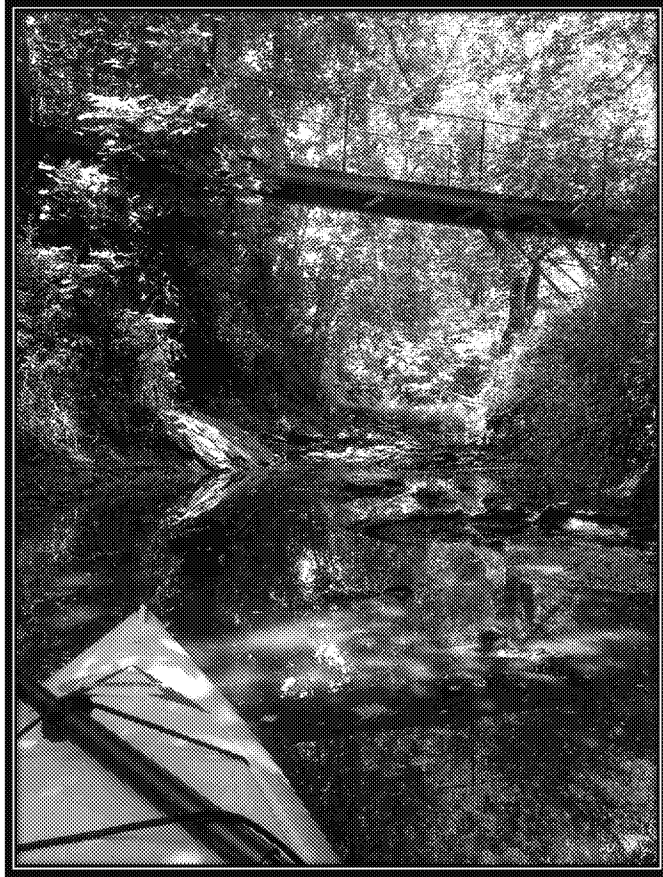


Ohio River Results (Detail)

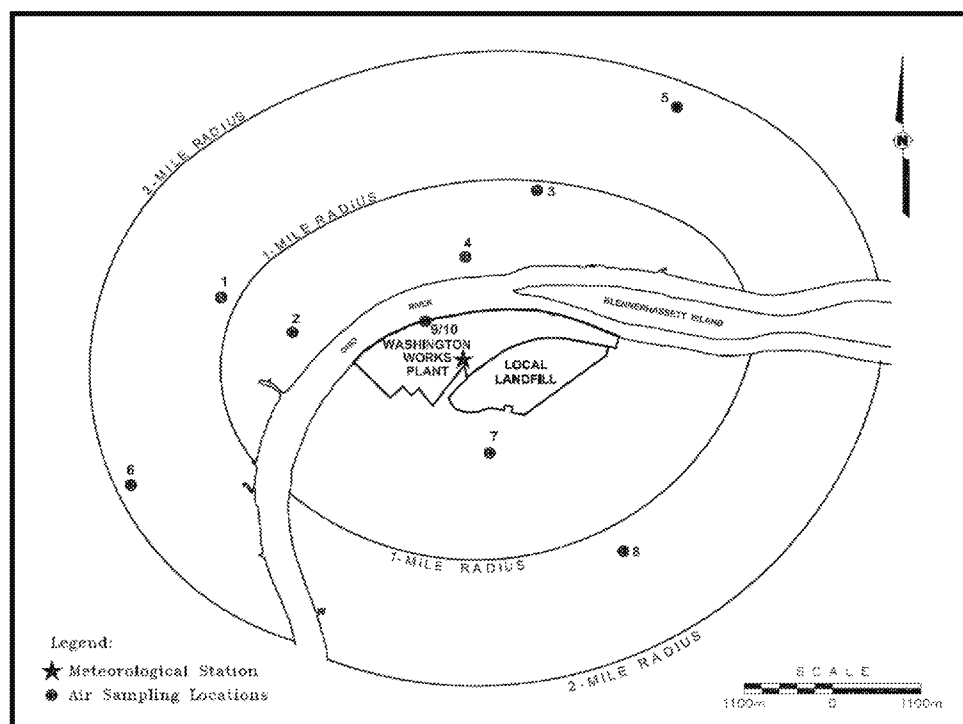


Trip #2 – Little Hocking River



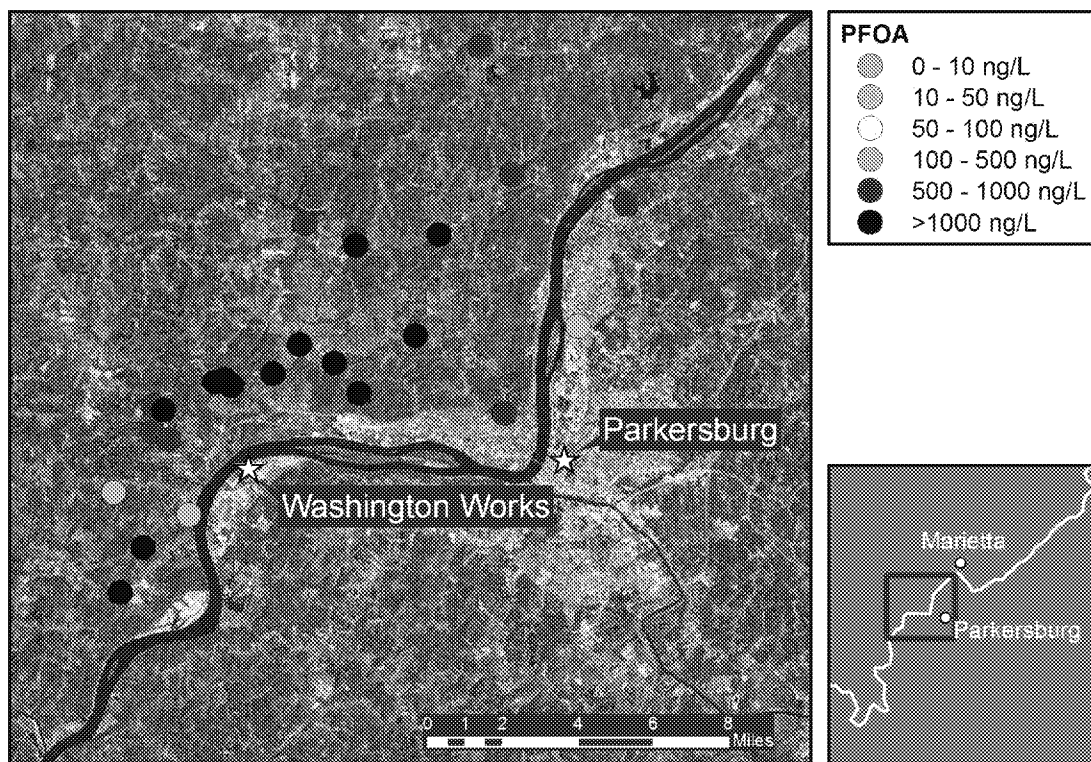


Air Monitoring Around Washington Works



Barton et al. *Journal of the Air & Waste Management Association* 2010, 60, 402–411

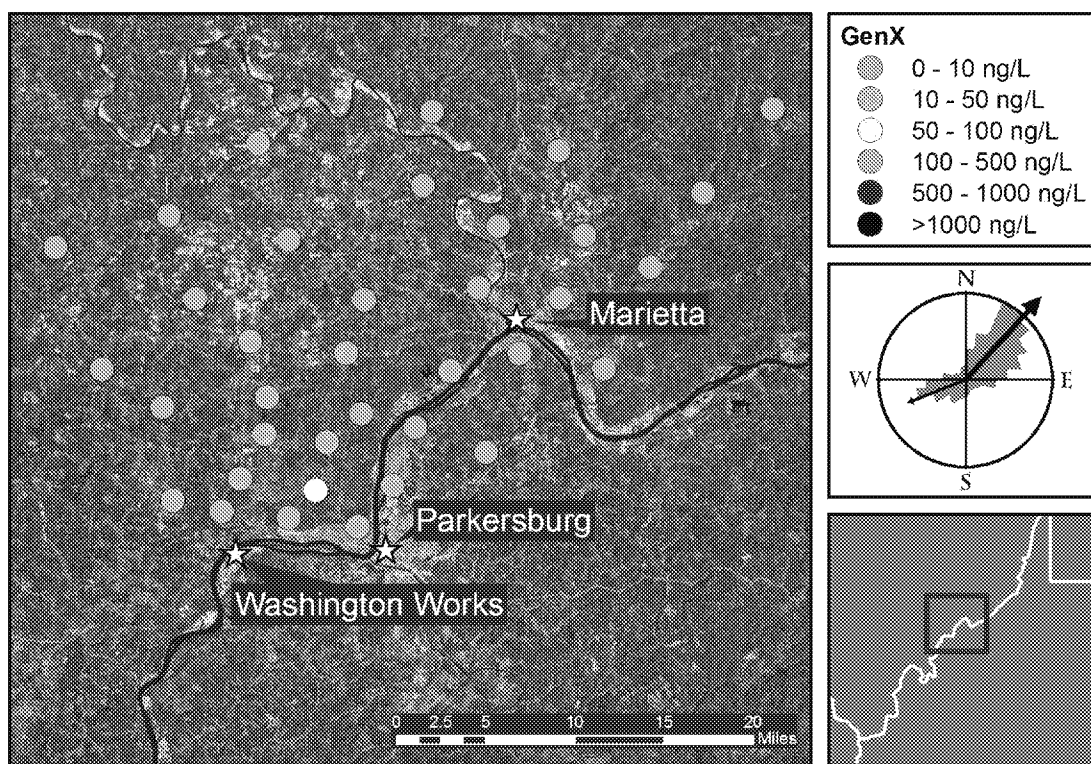
Little Hocking Results



Trip #3 – Little Hocking and Beyond



Extended Sampling Results



Conclusions

- The presence of significant levels of PFOA (>100 ng/L) in surface water more than 15 miles from the facility and quantifiable levels (>10 ng/L) more than 25 miles away suggest local contamination may be more extensive than originally thought
- The discovery of GenX at many of the collection sites suggests the replacement PFAS is contaminating the local environment via air deposition as well
- More testing is needed – especially private well water between the boundaries of the Little Hocking Public Water district and the Muskingum River

Questions?

Email: lindstrom.andrew@epa.gov
galloway.18@osu.edu

